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ABSTRACT

This paper illustrates how to teach parallel perspective using Cabri software. Examples include how to move/present cubes, how to use symmetry to draw a star from triangles, how to modify tessellations, and how to present circles by Cabri software. (Author/KHR)

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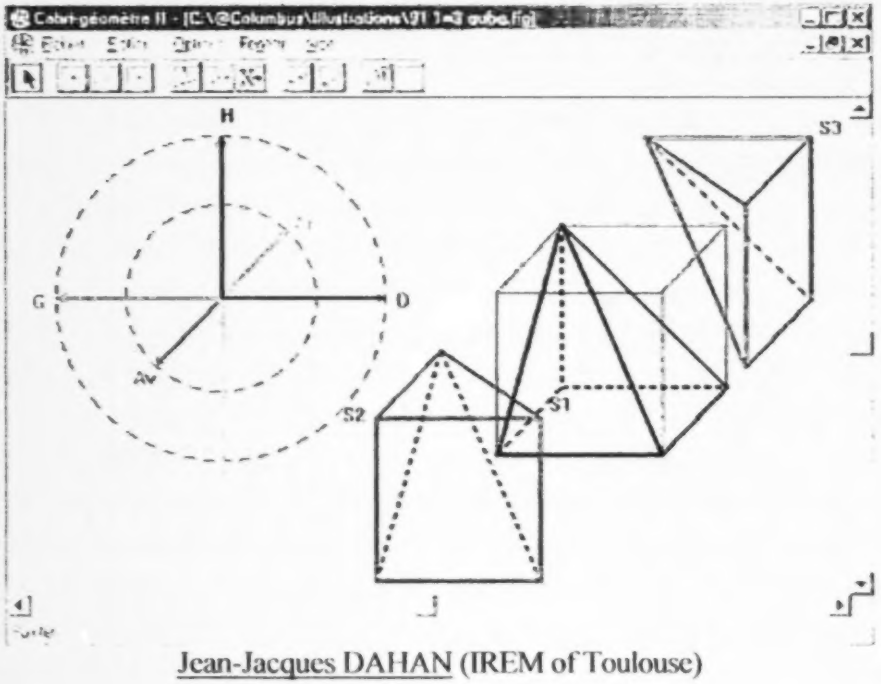
Parallel perspective with Cabri



Jean-Jacques DAHAN (IREM of Toulouse)

The 13th Annual T³ International Conférence
March 16-18, 2001 in Columbus (Ohio US)

1. Beginning with an animated perspective

The little farm in the prairy

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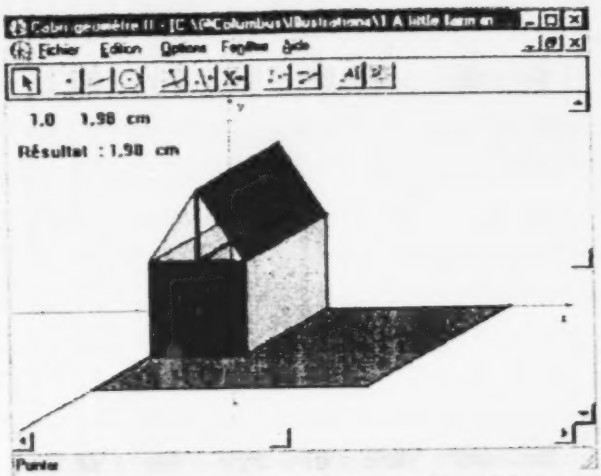
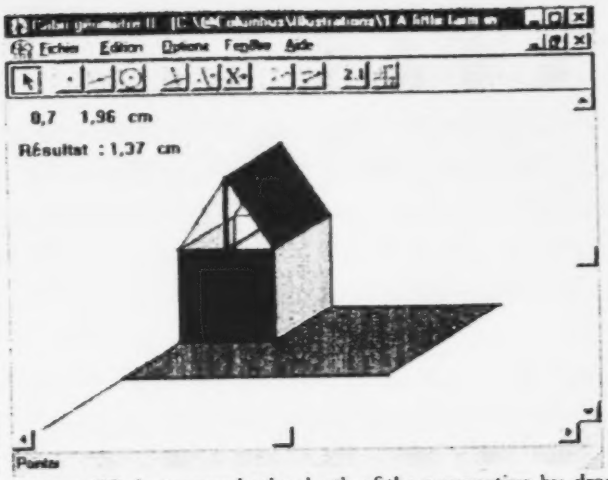
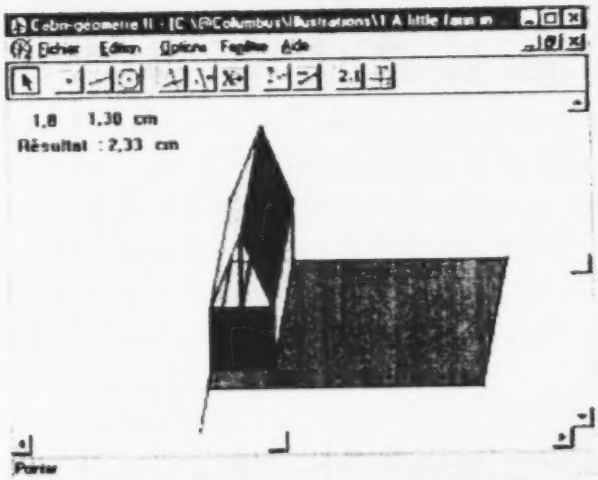
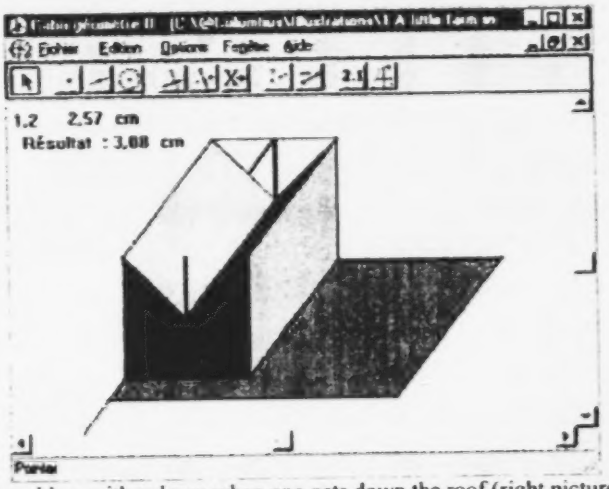


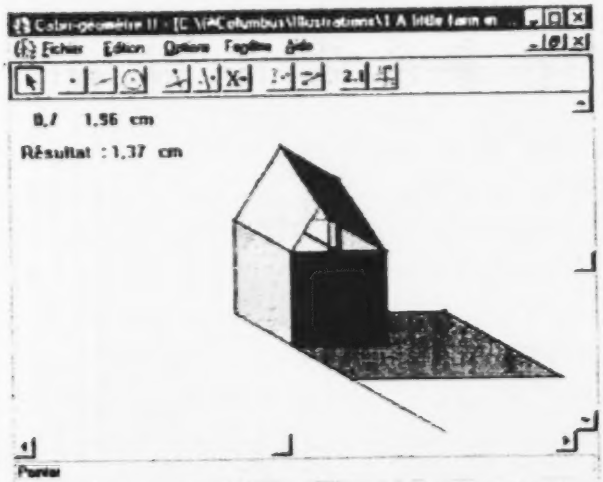


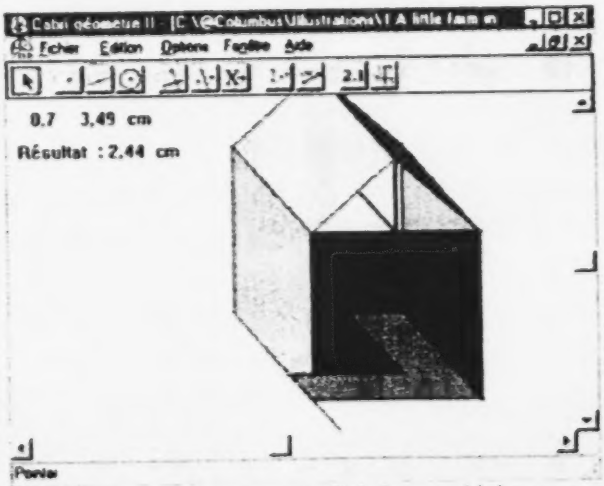
One can create this little farm with paper and pencil but one cannot modify instaneously the depth of the perspective by dragging a ray like here.





One can also modify the angle of vision (left picture). There is a problem with colours when one gets down the roof (right picture).





Problems are increasing by dragging other points and this plane picture that seemed to represent a little house with its green prairy in the space, now, gives us an odd impression.

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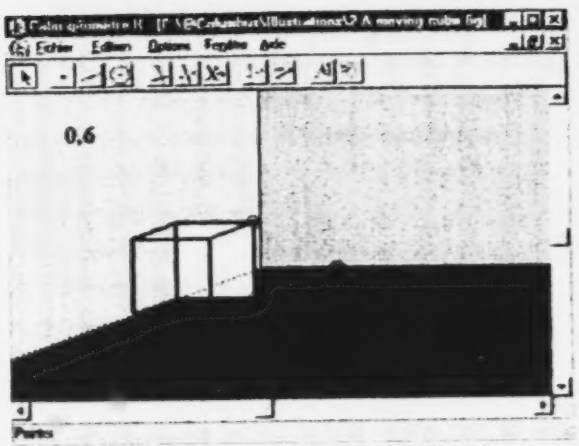
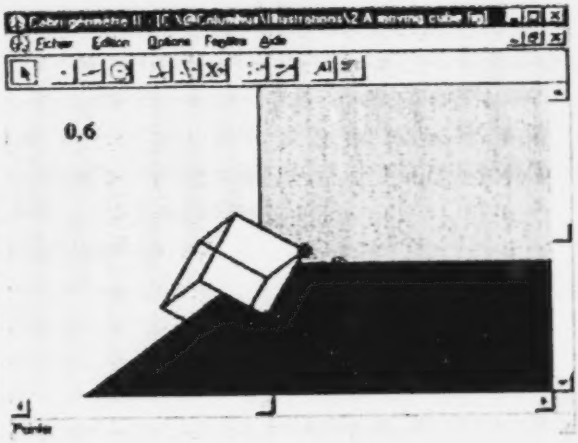
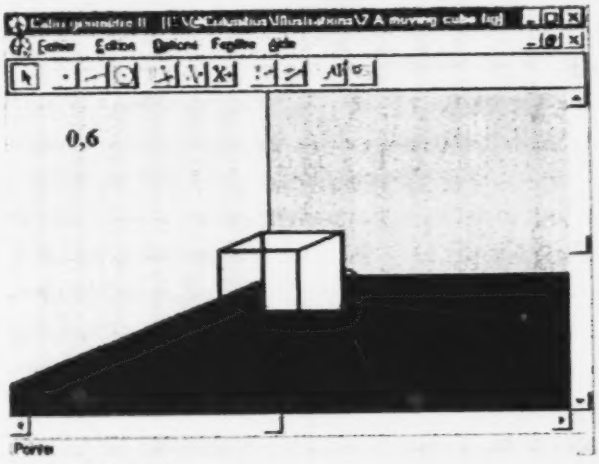
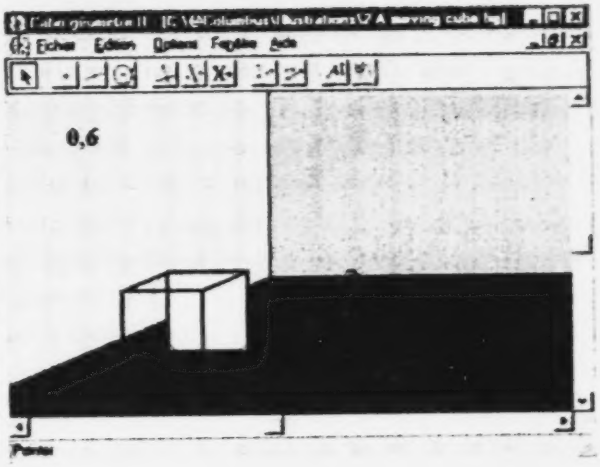
A moving cube



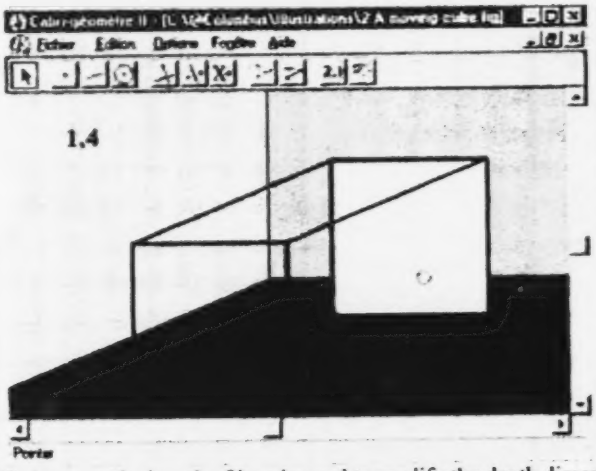


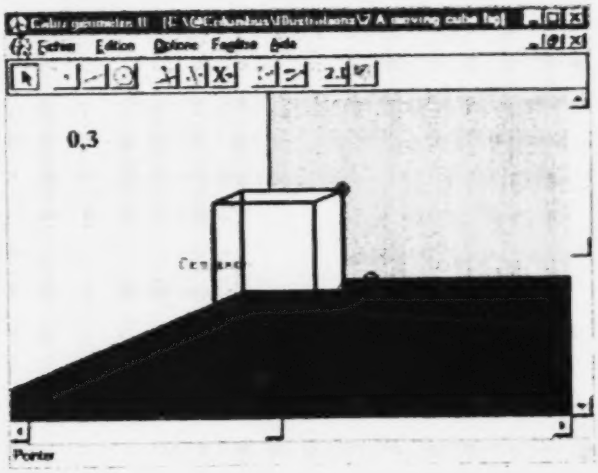
It is possible to rotate this cube around one of its edges.





To drag it forward.





To increase the length of its edge and to modify the depth dimension.

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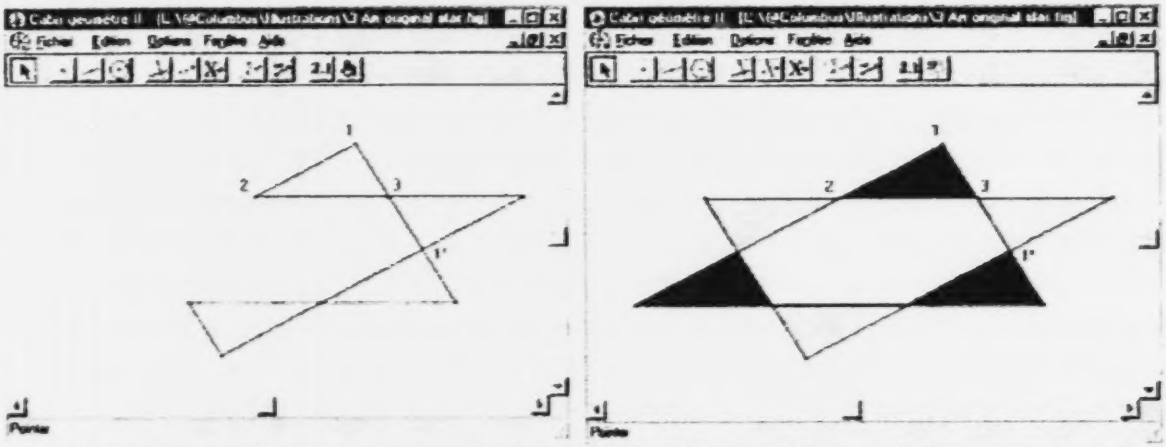
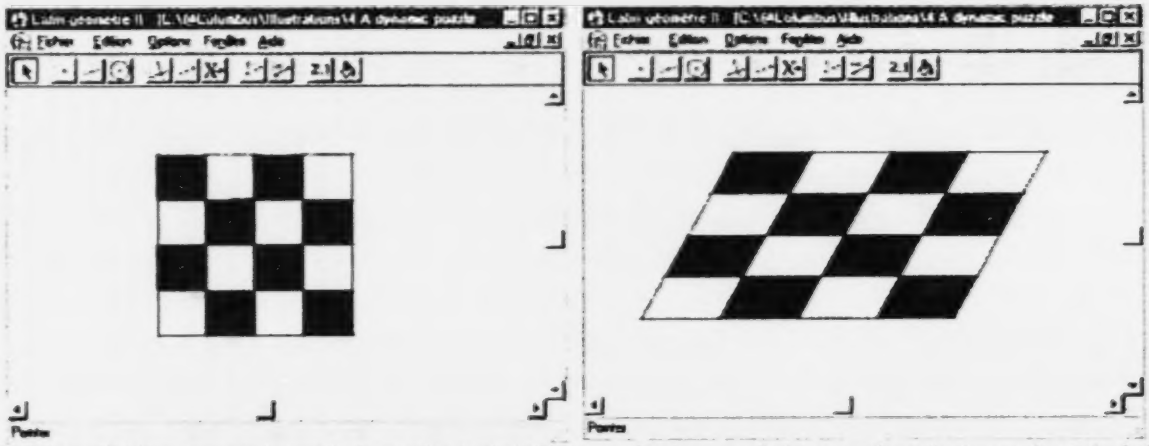
2. From plane to space

Triangles for a star

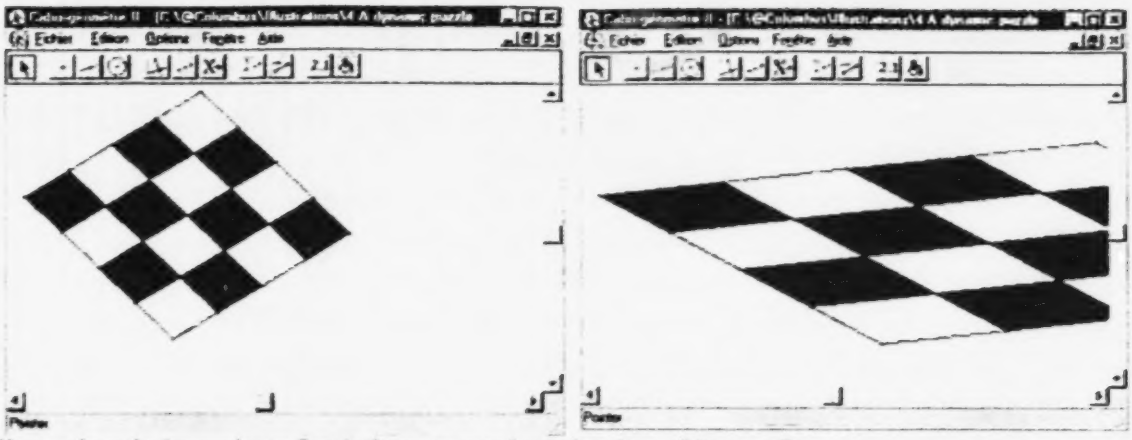


Starting from a triangle of the plane and using symmetries one gets the right picture; this one looks like a star drawn on the floor.

Twisting a first tesselation



This beautiful flag seems to be put in front of us in the left picture. On the second picture we have the impression to look the same flag from an other point of view.



Here we have the impression to float in the space an to have nice views of the same flag.

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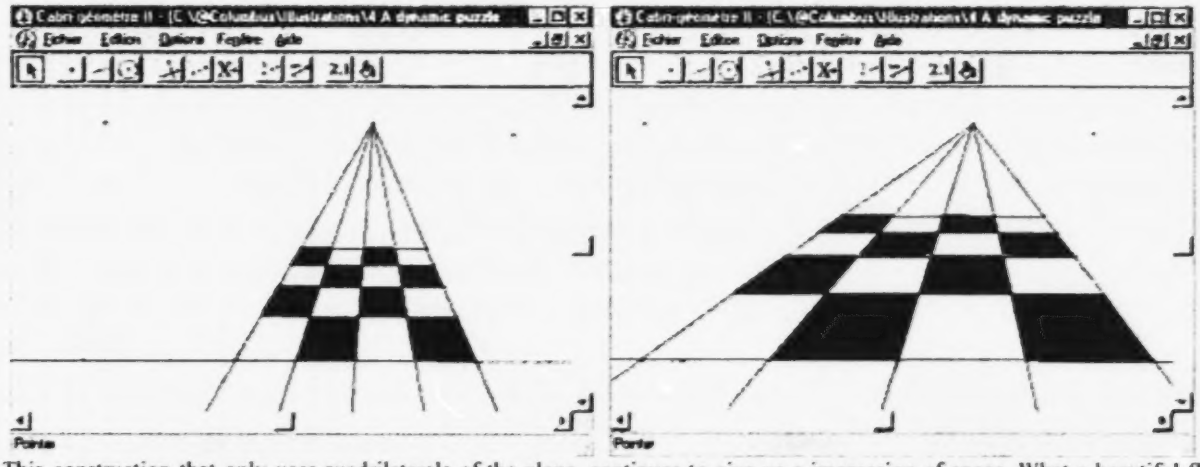
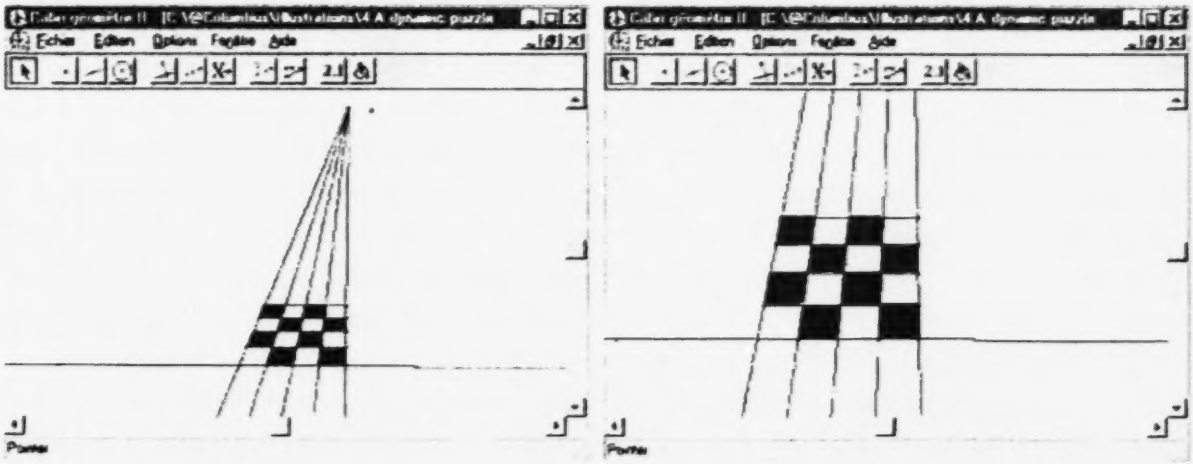
Modifying the parameters of a second tesselation



This construction that only uses quadrilaterals of the plane, continues to give us a impression of space. What a beautiful floor with a painter's point of view.



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Modifying like here some parameters of the construction leads us to the last picture where one gets a tesselation almost unscribed in a parallelogram (in this case, the vanishing lines seems to be parallèl).

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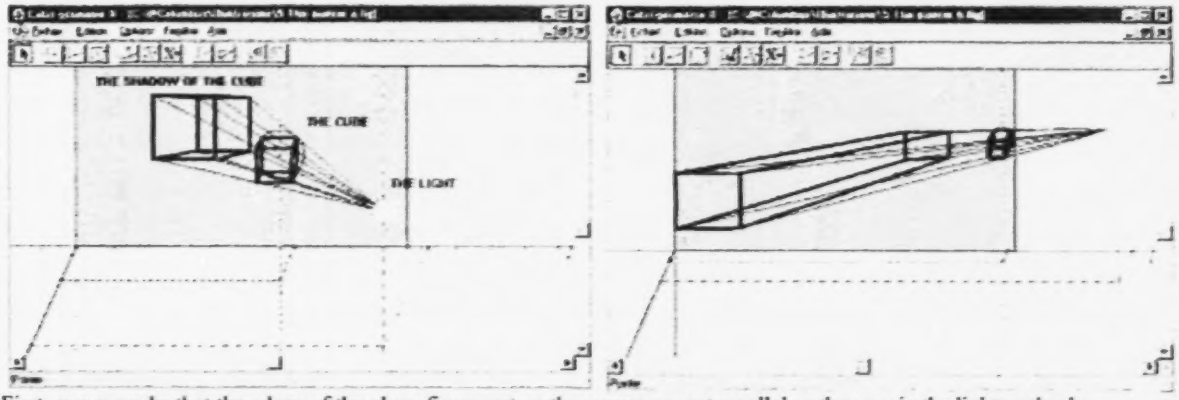
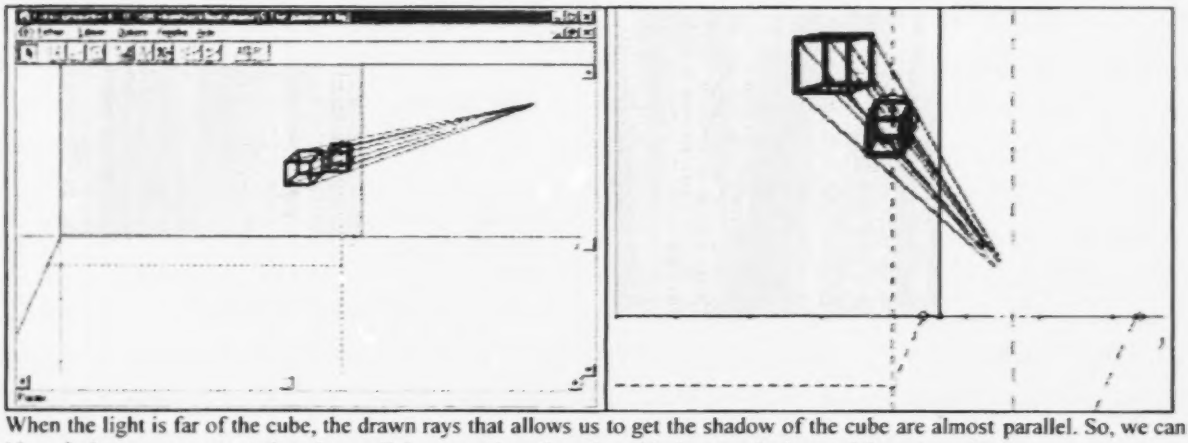
The shadow of the lightened cube on a blue screen



First, one remarks that the edges of the plane figure got on the screen are not parallel as they are in the lightened cube.
Second, the figure on the the screen can be longer than the lightened cube; it depends on the position of the light and the cube
Third, the dimensions of the shadow of the front side of the cube are wider than the dimensions of the shadow of the back side of the cube.

Do you want to experiment by yourself ? Click here and Click here



When the light is far of the cube, the drawn rays that allows us to get the shadow of the cube are almost parallel. So, we can have a good idea of what can representations in parallel perspective of a cube with the two shadows of these two pictures.

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Représention in parallel perspective on a blackboard

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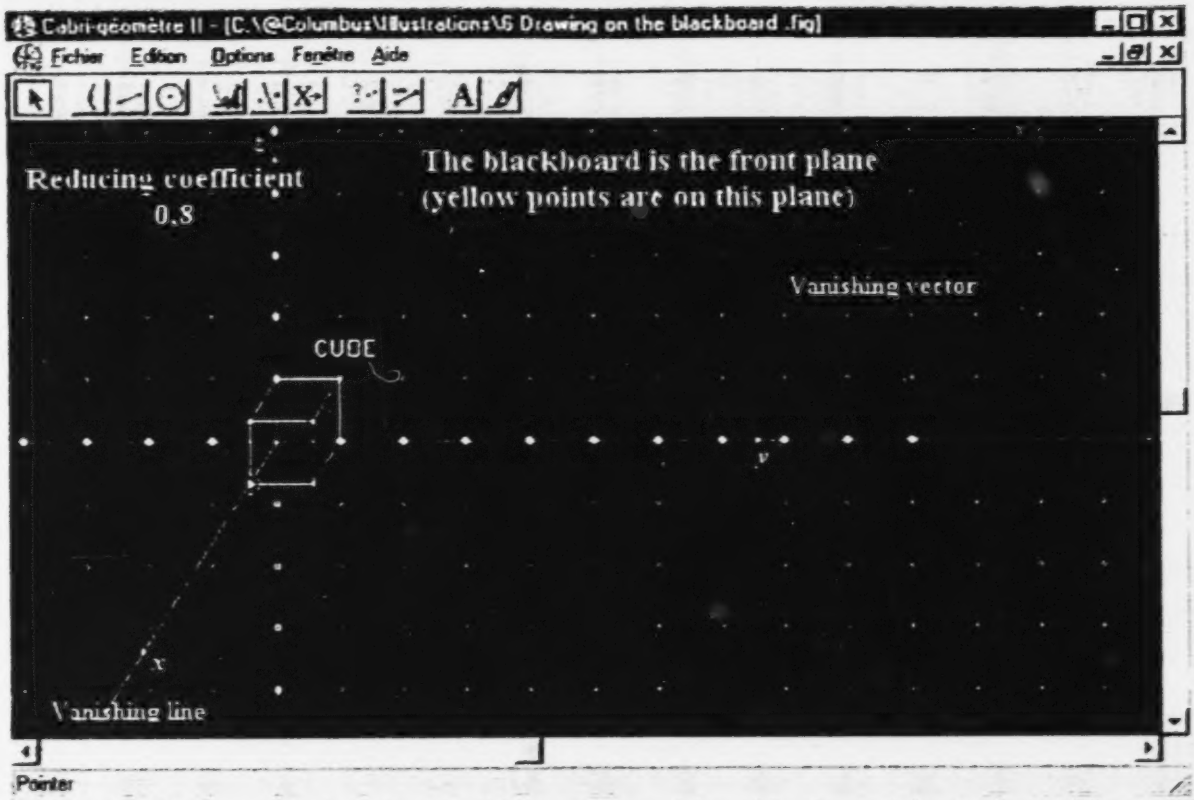


• The blackboard represents the front plane (parallel plane to the eyes'plane of the observer being standing). All figures of this plane are represented by their true dimensions (the unit is given on the system of axis(Oy,Oz))

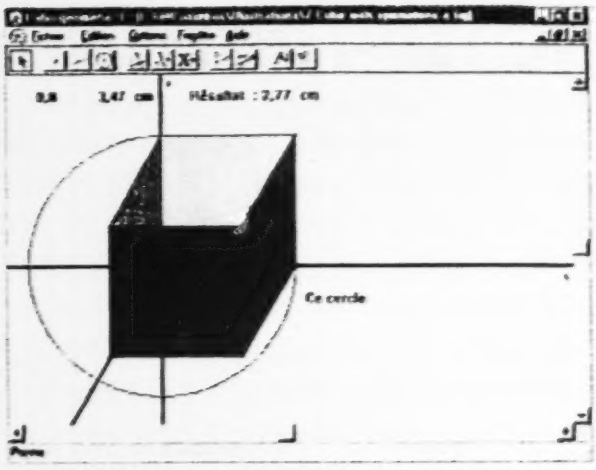
•• The drawn ray Ox represents the ray passing through O and perpendicular to the front plane: it is called "the vanishing line". All perpendiculars to the front plane will be represented parallel to this vanishing line.All figures of a any front plane (plane parallel to the initial front plane yOz) are represented also by their true dimensions.

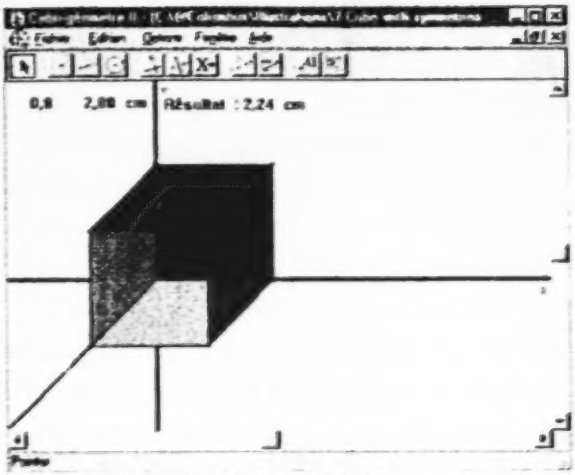
••• A number called "the coefficient of the perspective" (here 0,8) is the length on the vanishing line of a segment whose length is 1unit in the space. It can be also used to calculate the measurement L' of a segment whose measurement in the space is L with the formula:
L' = 0,8.L or in the general case : L' = k.L (where k is the coefficient of the perspective)

Do you want to experiment by yourself ? Click here

3. Representing cubes

Using symmetries

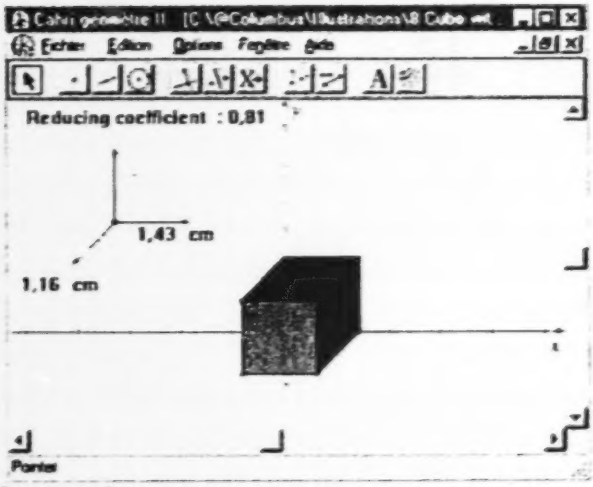


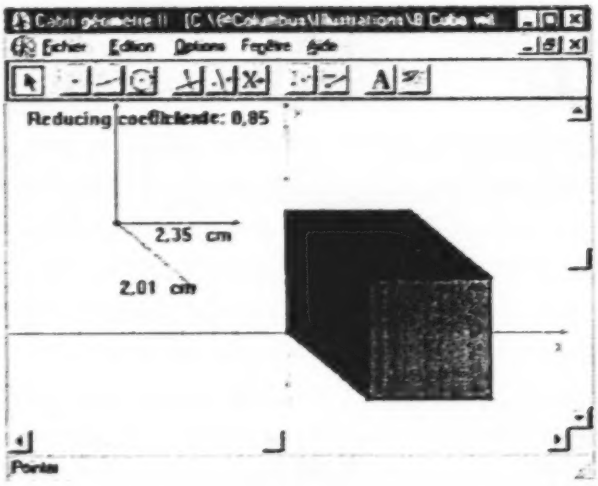


Here, it would be more intereseting to go to the cabrijava file and to ask for the constructions step by step.

Do you want to experiment by yourself ? Click here

Using translations





Same remark

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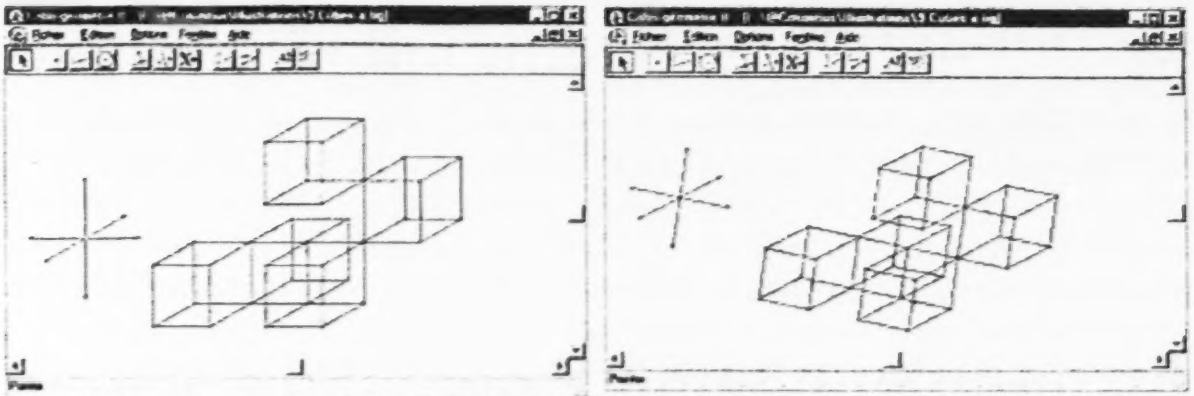
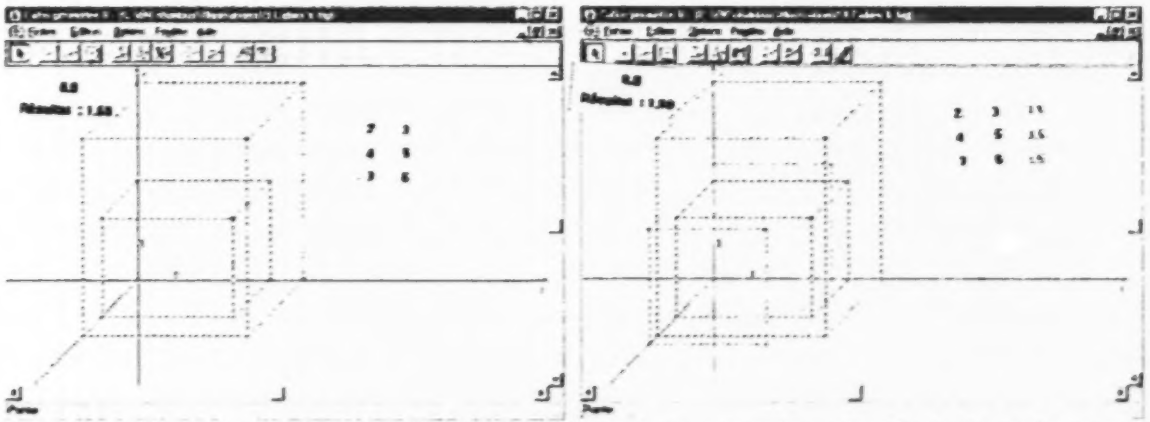
Using a macro



A macro is a tool we have created and which is added in the toolbar ; we have constructed a space tesselation of cubes using 8 directions.

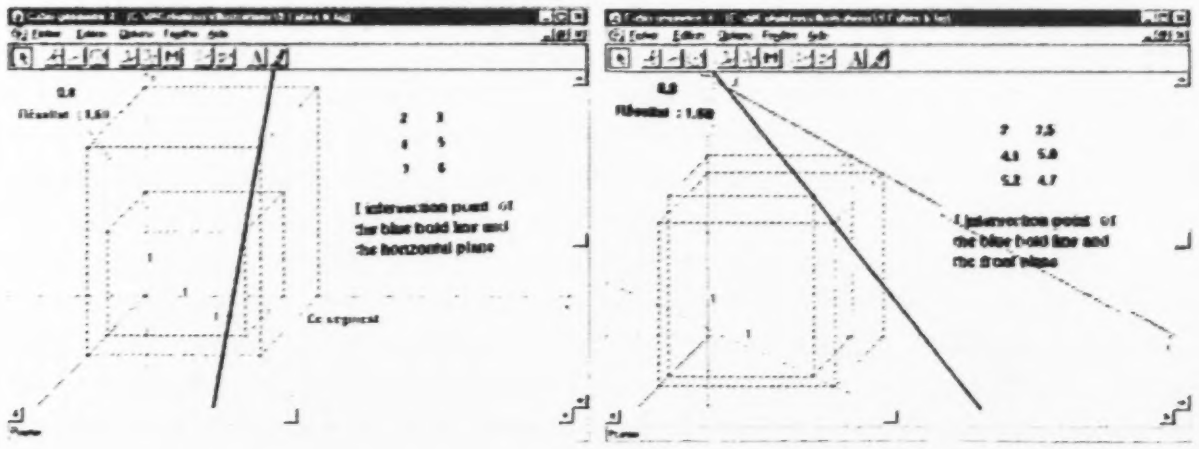
Do you want to experiment by yourself ? Click here

And also tesselations (using an other macro)



The macro used here, draws a point given with its three coordinates in the rectangular system of axis. To use this macro, we need to click on the system (Oy,Oz), on the vanishing line, on the reducing coefficient and on the three coordinates.

Leading to intersection problems



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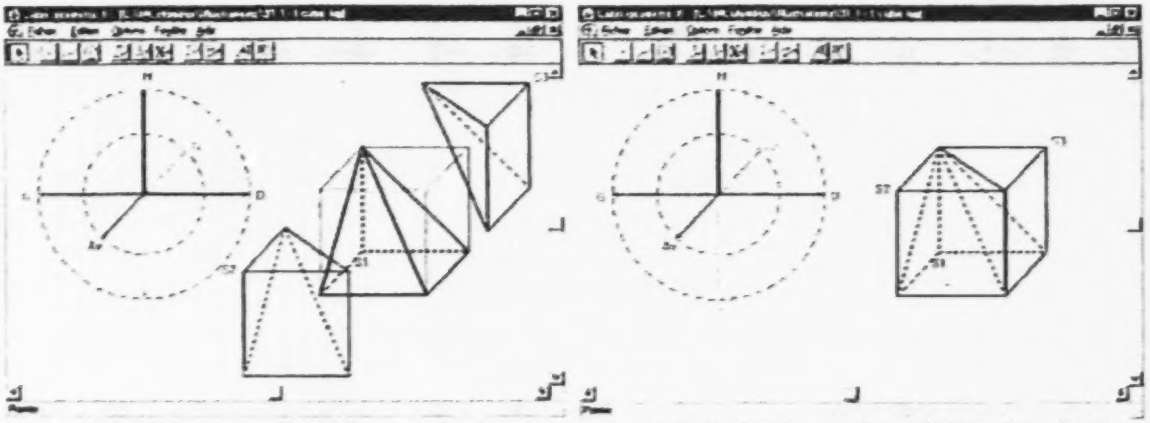
Each point constructed with this macro is given with its box. So, it is easy when one uses these boxes to find the intersection point of a line passing through 2 points created with this macro and the 3 planes defined by the axis.

Or to the construction of a cube with three tetrahedrons



Here is a beautiful example of a pertinent using of a special macro. One obtains the visual proof of the formula given the volume of a tetrahedron

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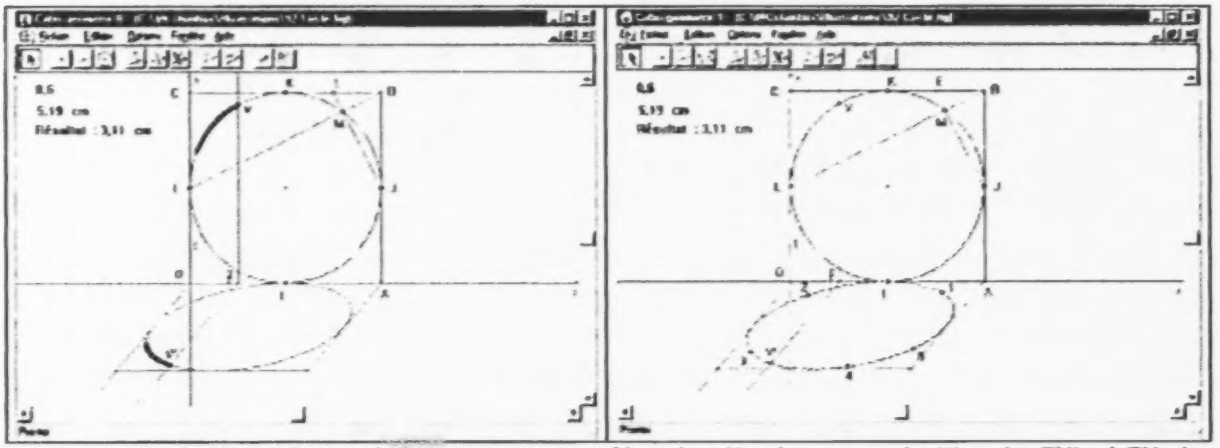
4. Représenting circles

5 particular points on a cercle



In order to rotate the blue circle around (OA), one rotate one of its points, V and one gets point V' so that TV' = k.TV where k is the coefficient of the perspective. One gets the green representation of the rotating circle by asking for the locus of point V' when point V moves on the blue circle.
In order to recognize the nature of this green curve, one draws the conic passing trough 5 points of this green curve and it seems that one gets the same curve than the green one; better, Cabri says us that this curve is an ellipse.

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Rotating a circle or a triangle of the front plane

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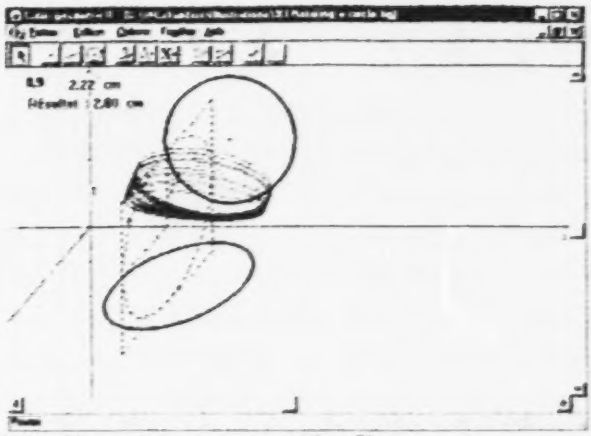
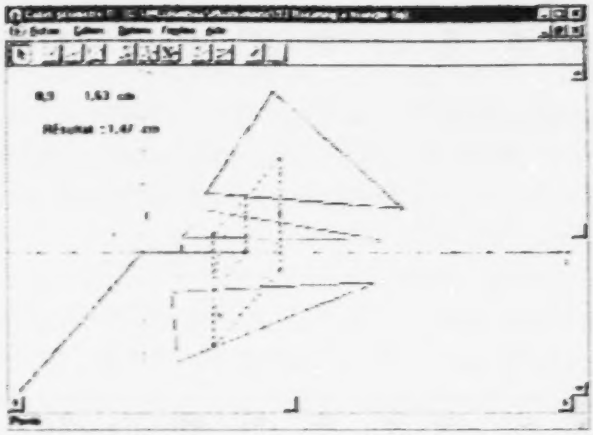

Using this property , one can get thes files.

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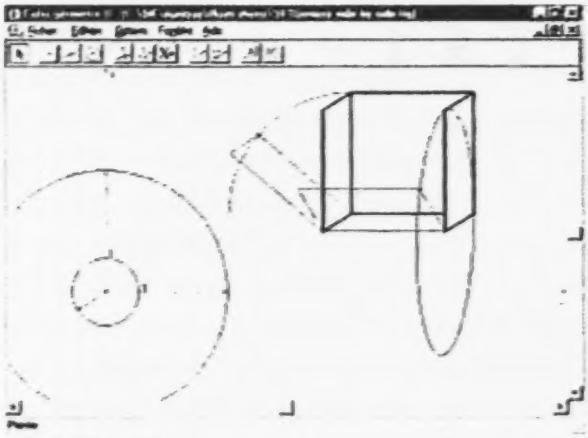
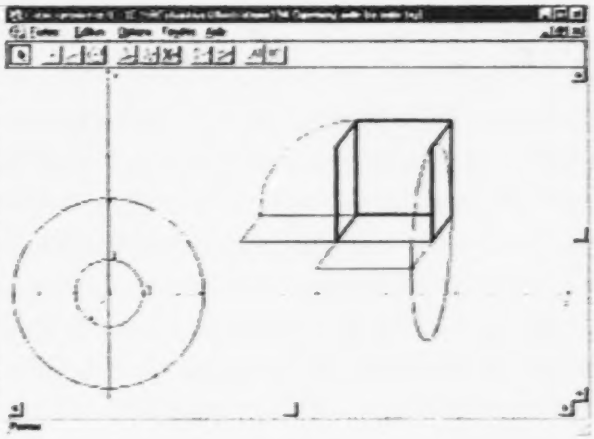
5. Opening cubes

Side by side

And also this one

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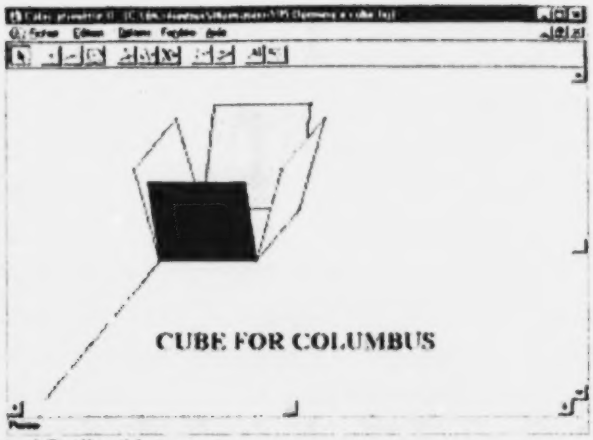
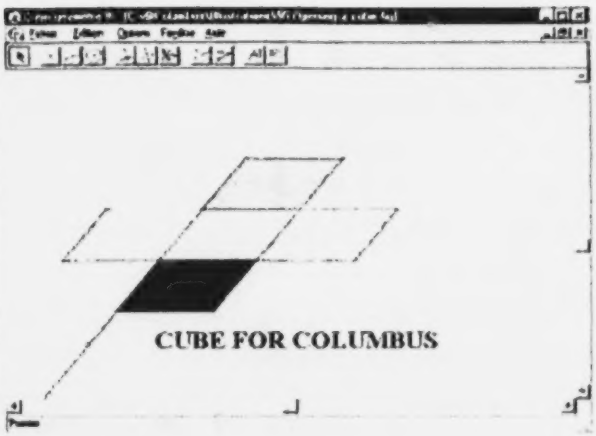
The four sides together





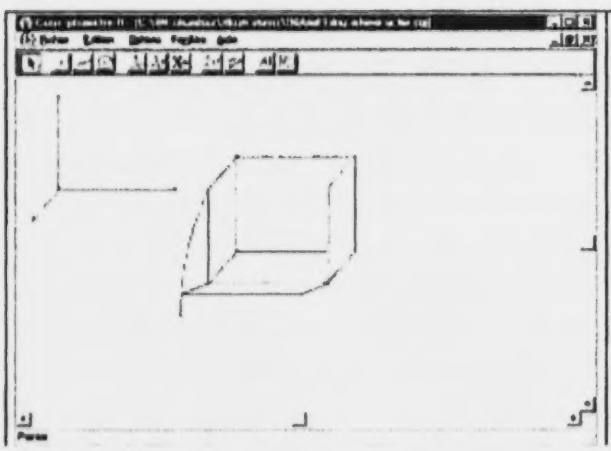
And finally, this one

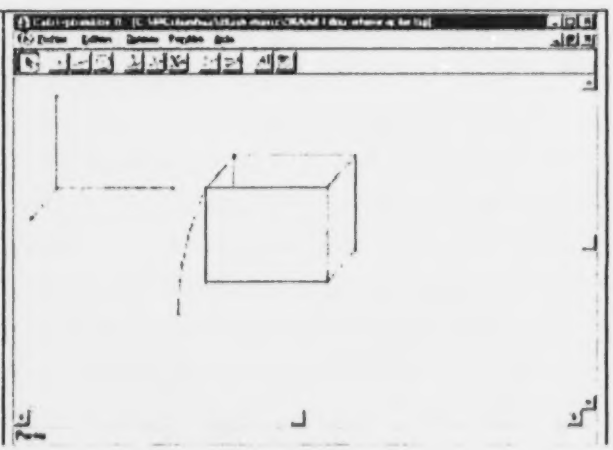
Do you want to experiment by yourself ? Click here

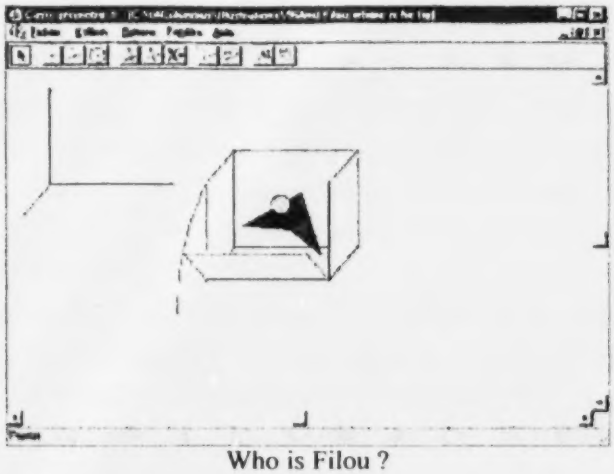
6. Conclusion

Using parallel perspective with Cabri, gives the opportunity of doing Math; you have certainly understood that my ludic way to present you all this files is a mask to hide you to attract you in a place where you will need to use a so beautiful software to do true and beautiful Math.

I have forgotten to speak about Filou







Who is Filou ?

He is my virtual son: I have created him in 1998. He appears in the book I have written (in French) "Introduction à la géométric avec la TI-92" (ELLIPSES Publishing) which is a ludic initiation of DGS Cabri in the TI-92. You will learn step by step how to construct each file with all the screenshots of all the following screens you must get. You will create moving cars, dancing Filous, laughing and crying suns and a lot of other files. So you will become quickly a DGS lover, for you and your students.

Do you want to experiment by yourself ? Click here

And now what happens? Click here

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